CALIFORNIA DIVISION OF MINES AND GEOLOGY

Fault Evaluation Report FER-12

March 14, 1977

1. Name of fault: Santa Ynez fault (south branch).

2. Location of fault: Gaviota, Sacate, and Solvang quads, Santa Barbara County (see index map, figure 1).

3. Reason for evaluation: This fault is in the first year's study area of the 10-year program for fault evaluation in the state. Also, the fault is classified as "active" in the Santa Barbara County Seismic Safety Element (Moore and Taber, 1974).

4. List of references:

a) Dibblee, T.W., 1950, Geology of southwestern Santa Barbara County: California Division of Mines and Geology, Bulletin 150, 95 p., scale 1:62,500.

b) Vedder, J.G., et al., 1974, Preliminary report on the geology of the continental borderland of southern California: U.S. Geological Survey, Miscellaneous Field Study Map MF-624, map sheet 3, map scale 1:250,000.

c) Willott, J.A., 1972, Analysis of modern vertical deformation in the western Transverse Ranges, California: M.A. thesis, University of California at Santa Barbara, 81 p.

d) Jennings, C.W., 1975, Fault map of California: California Division of Mines and Geology, Geologic Data Map Series, Map no. 1 (scale 1:750,000).

e) Moore and Taber, 1974, Santa Barbara County comprehensive plan -- Seismic Safety Element, 93 p.

f) Ziony, J.I., 1971, Quaternary faulting in coastal southern California in Geological Survey research 1971, Chapter A: U.S. Geological Survey professional paper 750-A, p. 167-168.

g) Cleveland, G.B., 1973, Late Quaternary sedimentation in Ventura County in Geology and mineral resources study of southern Ventura County: California Division of Mines and Geology, Preliminary Report 14, — p.

h) Valentine, J.W., and Lipps, J.H., 1967, Late Cenozoic history of the southern California islands: Proc. Sup. Bio California lands: Santa Barbara Botanic Gardens, p. 21-35 (cited in Cleveland, 1973, p. 30).

i) Ziony, J.I., et al., 1974, Preliminary map showing recency of faulting in southern California: U.S. Geological Survey, Miscellaneous Field Studies Map, MF-585.

j) Weaver, D.W., and Dibblee, T.W., 1965, Guidebook-Western Santa Ynez mountains, Santa Barbara County, California: Coast Geological Society, 1965 guidebook, 47 p.

k) NASA, U-2 aerial photographs, False-color IR, flight number 73-194, roll 01541, frames 6519 to 6521.

l) United States Department of Agriculture photos, HA-303, frames 16-21, 27-30.

5. Summary of available data:

a) Description -- The south branch of the Santa Ynez fault was originally mapped by Dibblee (1950) in the early 1930's. He shows the fault extending from about 4 miles offshore northeast for about 10 miles where it merges with the main east-west trace. Dibblee also shows the

Vedder (1974) shows the fault offshore. Dibblee maps it's onshore extent

Fig. 1
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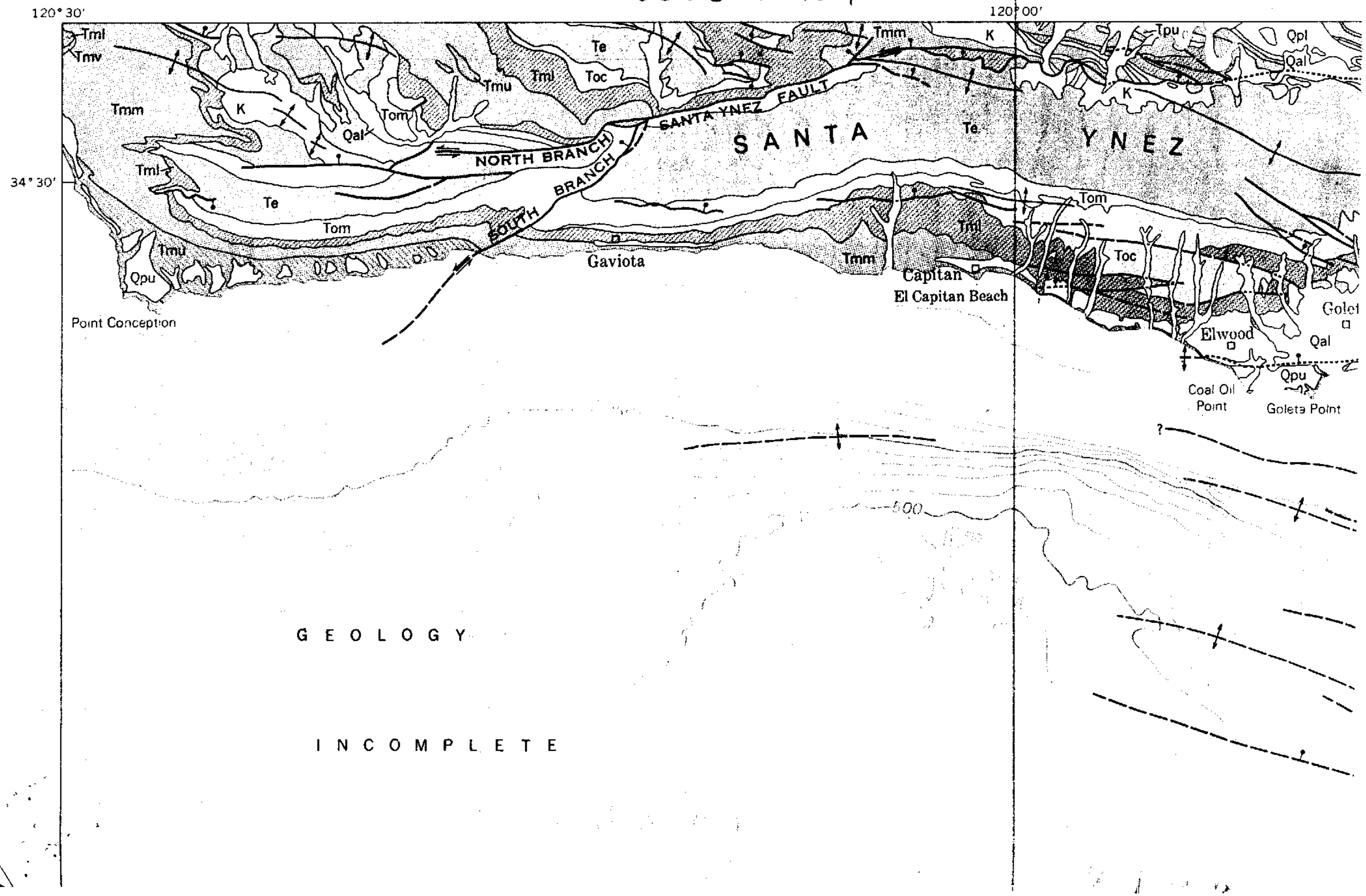
(copied from Vedder, et al., 1974)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Scale 1:250,000



fault to bifurcate at the northeast end and to branch in at least two other places (see figure 1). Geologic evidence of faulting is apparent along the fault where the contact between upper and lower Monterey Formation apparently is offset left-laterally, and where rocks of the Rincon and lower Monterey Formations are in contact. The fault dips between 60 and 85 degrees to the NW. Dibblee shows the SE side of the fault to be up relative to the NW. Weaver and Dibblee (1965, p. —) show conflicting evidence as to the nature of the principal movement along this fault.

The main Santa Ynez fault zone has nearly 2 miles of vertical offset postulated on the eastern and east-central portions of the fault. However, according to Dibblee, vertical offset on the south branch decreases toward the west from Gaviota Pass and the fault possibly dies out under the ocean.

b) Recency -- Evidence of Quaternary movement along the south branch is shown by Dibblee at the mouth of Alegria Canyon (see Locality 3, plate 1).

no ¶ Here, a 200-foot elevation terrace deposit is faulted. ~~Since there are~~ Based on terrace levels at other locations with a lower elevation (the 75-foot terrace level has been dated by Valentine and Lipps (1967, p. 25) at 120,000 years in Ventura County as cited in Cleveland, 1973), the age of this terrace seems reasonably to be over 100,000 years and possibly as old as 500,000 years. A soil developed on this terrace deposit is reported to be unfaulted according to Ziony (1971). He states (p. A-168) "trenching at this site showed no evidence of faulting in this probable Holocene age soil."

Ziony's classification of this fault is late Quaternary. Jennings (1975) also shows this fault as Quaternary. Vedder (1974) says that indications of a scarp in the bedrock offshore put this fault in the very latest Pleistocene and possibly Holocene category (see figure 1). Moore and Taber classify this fault as active apparently on the basis of reported historic elevation changes (see Willott below).

Willott (1972, p. 30), using data from a precise level line survey, states that the south branch of the Santa Ynez fault is the cause of a 1.5 cm elevation change (east side down) over the last 11 years. This change, he says, takes place between two precisely surveyed benchmarks located on the Southern Pacific rail lines (see plate 1). However, other elevation changes 3 or 4 times as great occur within 10 km either side of this location (see figure 2). No known faults exist at these other locations and no explanation is given for their existence. Willott's data does seem to show that the entire area eastward from Pt. Conception is tilting or subsiding to the east. Choosing one small elevation change out of multitudes of other anomalies and attaching it to the Santa Ynez fault does not appear to be appropriate.

6. <u>Interpretation of air photos:</u>

Both high altitude U-2 photos and large-scale low-altitude photos were studied. Only the larger features were visible on the U-2 photos; namely saddles, high scarp faces, and notched ridges. However, these features, along with field observations, serve to identify a zone of faulting as much as 300 feet wide. The location of the fault zone on these photos generally follows Dibblee's mapped fault trace.

The large scale photos, borrowed from U.C. Santa Barbara, show the following features not seen on the U-2 photos: 1) a low south-facing scarp in the terrace deposits just west of Alegria Canyon (pl. 1, Location 4);

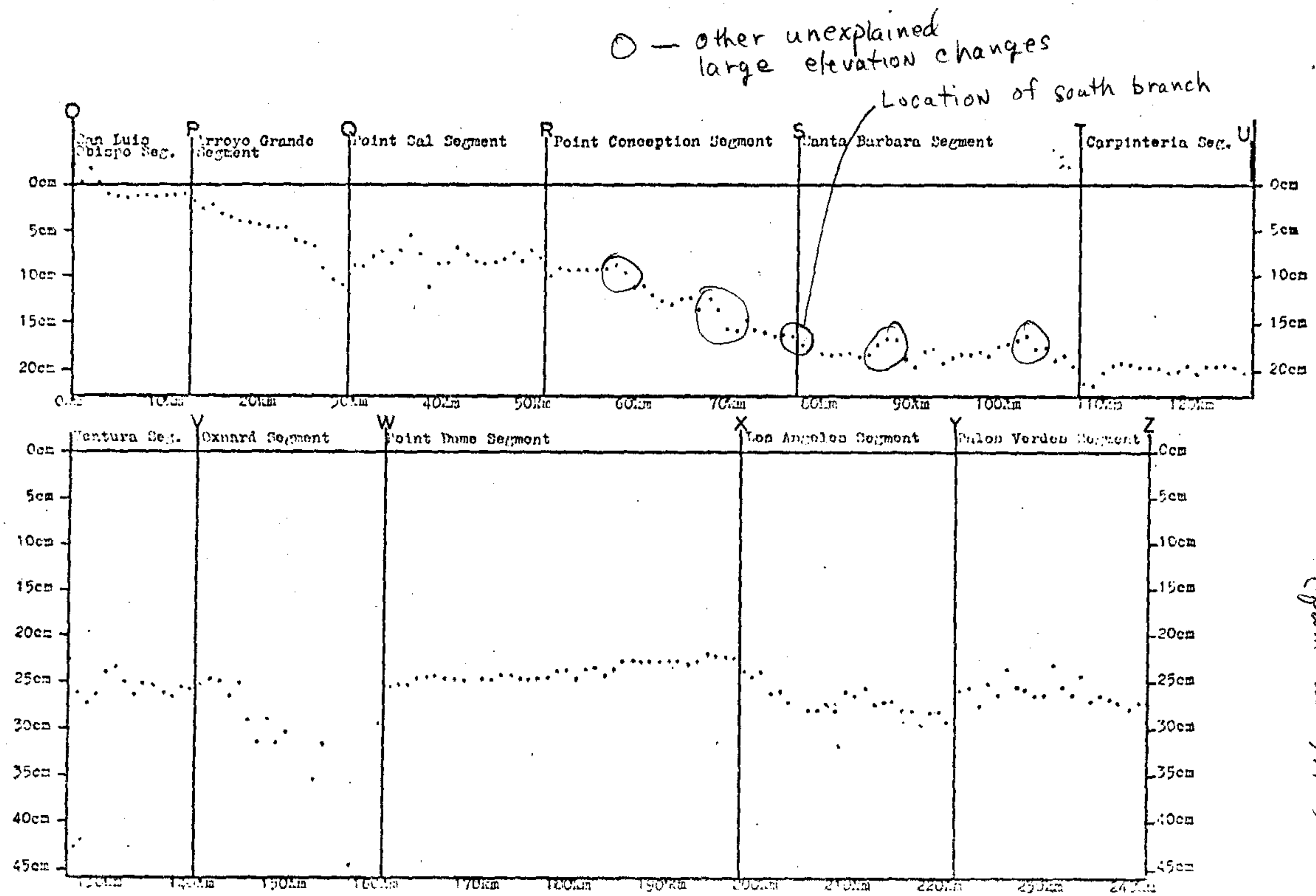


Fig. 10. Graph of the change in elevation between 1957 and 1974. 1957 elevations set at zero. Dots signify bench marks.

Fig. 2 (from Willott, 1972)

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2) a more or less continuous, low north-facing scarp which follows the contact of Monterey and Rincon rocks between Alegria Canyon and a saddle west of Aqua Caliente Canyon (Location 5 to 7). Farther northeast a series of notched ridgelines locally mark the trace of the fault northeast of the word "Las Cruces".

7. Field observations:

The following field observations were made along the south branch of the Santa Ynez fault (numbered localities on plate 1 correspond with numbers below):

1) Contorted beds of the Monterey Formation (Tm) outcrop in a roadcut on the east side of Alegria Canyon. These contorted beds appear to lie along the trace of the fault mapped by Dibblee. Possible topographic evidence of faulting exists at this locality north of the contorted beds where a sharp break in slope generally follows the fault as mapped by Dibblee. However, this change in slope is probably due to erosion of the less resistant siltstones of the Rincon Formation, which are mapped by Dibblee on the north side of the fault.

2) A roadcut on the west side of Alegria Canyon reveals the following features (see figure 3 and 4 for sketches and accompanying photos): An approximately 30-foot wide gap between exposures of highly contorted beds of Monterey Formation can be seen at this locality (just north of figure 4). The gap has about 10 feet of colluvial debris in it. South of this gap, approximately 15 feet, Tm is faulted against colluvium (see figure 3). The fault extends upward into the overlying colluvium. Tm beds on the south side of this fault show drag folding indicating north side down relative to the south. It was not possible to observe whether or not

Fig. 3 FER 12

Close-up view of Fig. 4.

Co – Colluvium

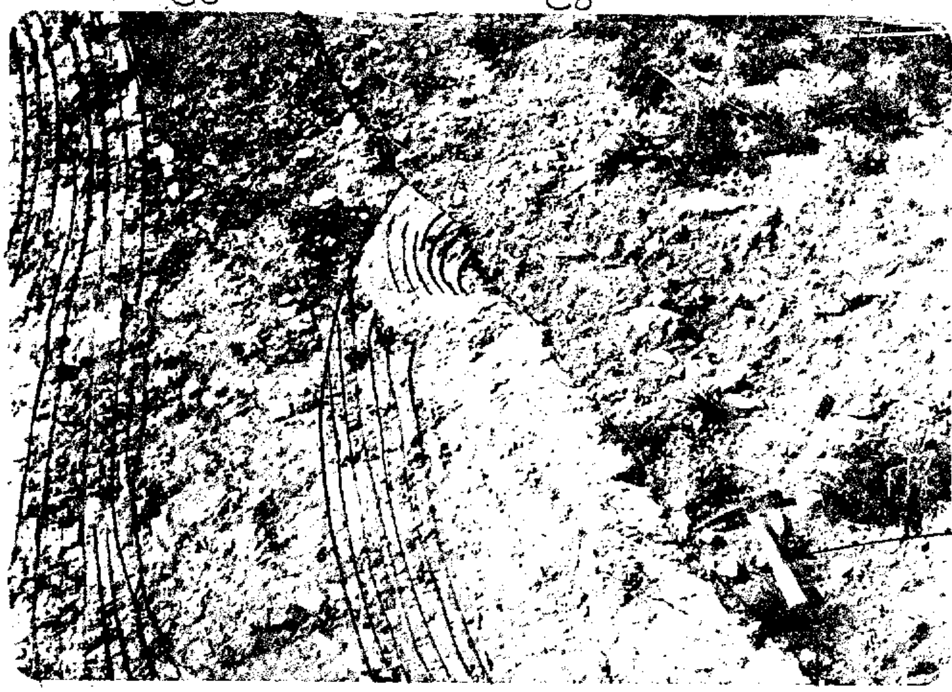
Tm – Monterey Formation

—— Fault

Fig. 3 FER 12

Close-up view of Fig. 4.

Co Co



Hammer

Tm (bedded) Co Tm (bedded) CONTORTED Tm Co

Fault N 75°E 80°N

Co – Colluvium

Tm – Monterey Formation

Fault

this trace extends to the surface or cuts the thin soil horizon. This fault strikes N 75° E and dips 80° northerly. This strike is 15-20 degrees off the strike as Dibblee maps the fault and may only be a branch of the main fault. Immediately south of this fault is a 15' section of beds of Tm standing on end (see figure 4). The southern margin of these beds is possibly bounded by another fault having nearly the same attitude as the fault just described. This fault (?), however, does not appear to extend upward into the colluvium. Immediately to the south of these beds is a near vertical section of Tm dipping to the north.

On the north side of the gap in the Monterey roadcut exposures is another section of moderately contorted beds. No faulting was observed in this section. It is possible that the main trace of the fault passes through the gap and is causing these beds to be contorted.

3) This locality is located up slope from number 2 where a fault crosses a NW-SE trending spur (see figure 5). Here a cut made for an old road provides a fairly well exposed section. The beds of the Monterey Formation again are contorted and sheared. Again, a gap (narrower than at 2) exists in the Tm beds. Colluvium has filled this gap. At the south margin of the gap a 2" wide fault gouge zone forms the boundary between the colluvium and the sheared and contorted Tm. The fault possibly extends upward into a gravelly terrace material. Some of the gravel at the base of the terrace is mixed in with the gouge. So it would seem that faulting occurred during or after deposition of the terrace deposit. The most important evidence found at this outcrop is that a one-foot thick, poorly developed soil overlying these units appears to be unfaulted. In fact, the fault could not be traced completely through the terrace materials.

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Fig. 4

Looking west at roadcut [illegible]

scale 10'

Tm – Monterey formation

Fault

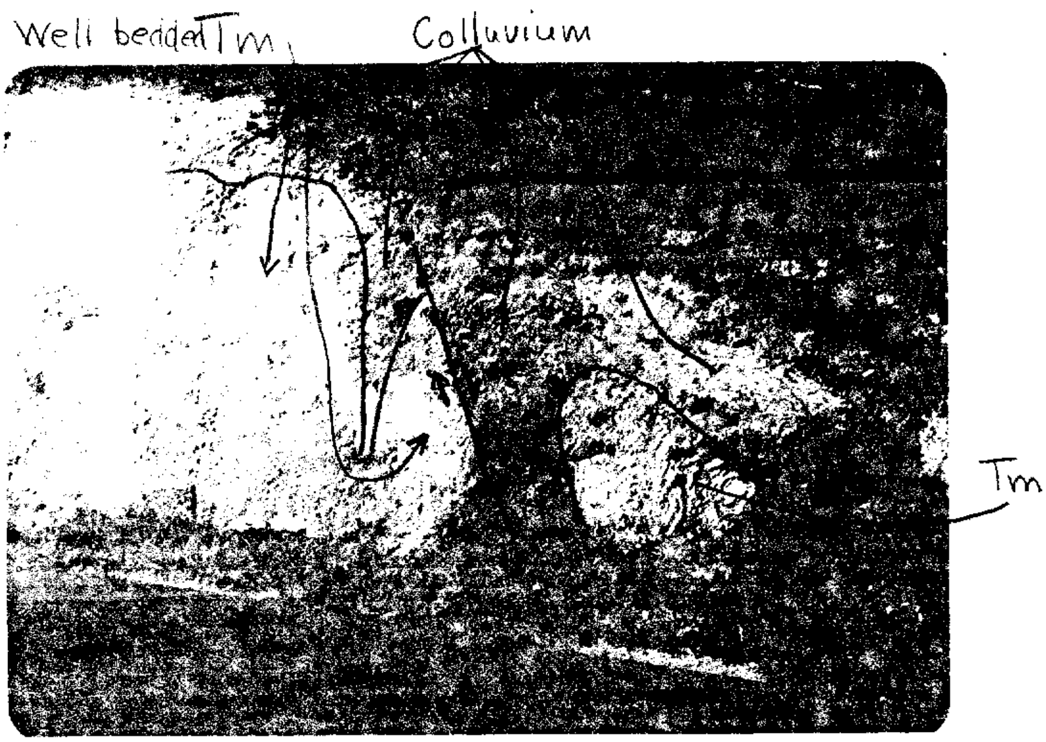
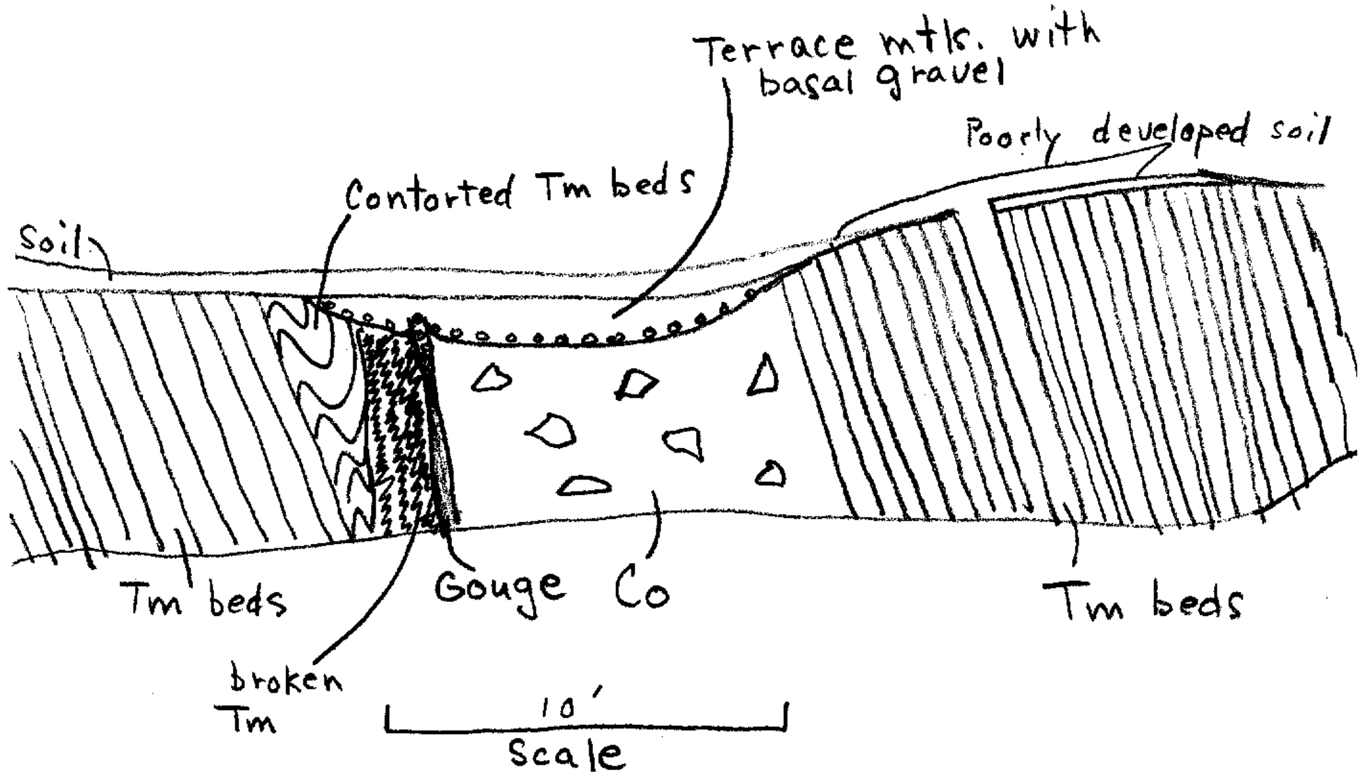


Fig. 5

View looking west above Olegria canyon on the west side.



Gouge = fault N70°E, vertical to steep northerly dip

Tm – Monterey Formation

Co – Colluvial debris

4) Locality 4 (between the two leaders on plate 1) appeared to be a low, south facing scarp on air photos. Grading for a road and new housing has destroyed any evidence that might have been there.

5) Sheared and broken shale beds in the Monterey Formation were seen nearly 200' away from the trace of the fault as mapped by Dibblee. The attitude of the shears is N 60° E and they appear to be vertical. If this feature is to be considered part of the Santa Ynez fault zone then the fault zone is at least 200' wide.

6) Sheared mudstones of the Rincon Formation visible in a low roadcut on the trace of the fault. Attitude of shears is N 50° E with a 70° NW dip.

7) Sheared and crumpled sandstone beds of the Vaqueros Formation are exposed in a saddle west of Canada del Agua Caliente. This saddle represents possible topographic evidence of faulting.

8) A sandy terrace deposit and an overlying, lense-shaped, gravelly fan deposit are exposed in a railroad cut for nearly 200 m at locality 8. The gravelly unit pinches out abruptly to the east in the general vicinity of the fault as mapped by Dibblee. The possibility exists that this gravelly unit is truncated by the fault, but no evidence of faulting was seen in the terrace materials.

9) Beds of the Monterey Formation, striking N 80° E and dipping 55° SE, are exposed in the seacliff (see figure 6). About 300 feet west of this outcrop are beds of the Siquoc or Monterey Formation which generally strike N 25° W and dip 30° SW. Within this 300-foot zone are poorly exposed, highly contorted, and sheared Monterey beds. At the eastern margin of this disturbed zone, the Monterey Formation is overlain by

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Fig. 6

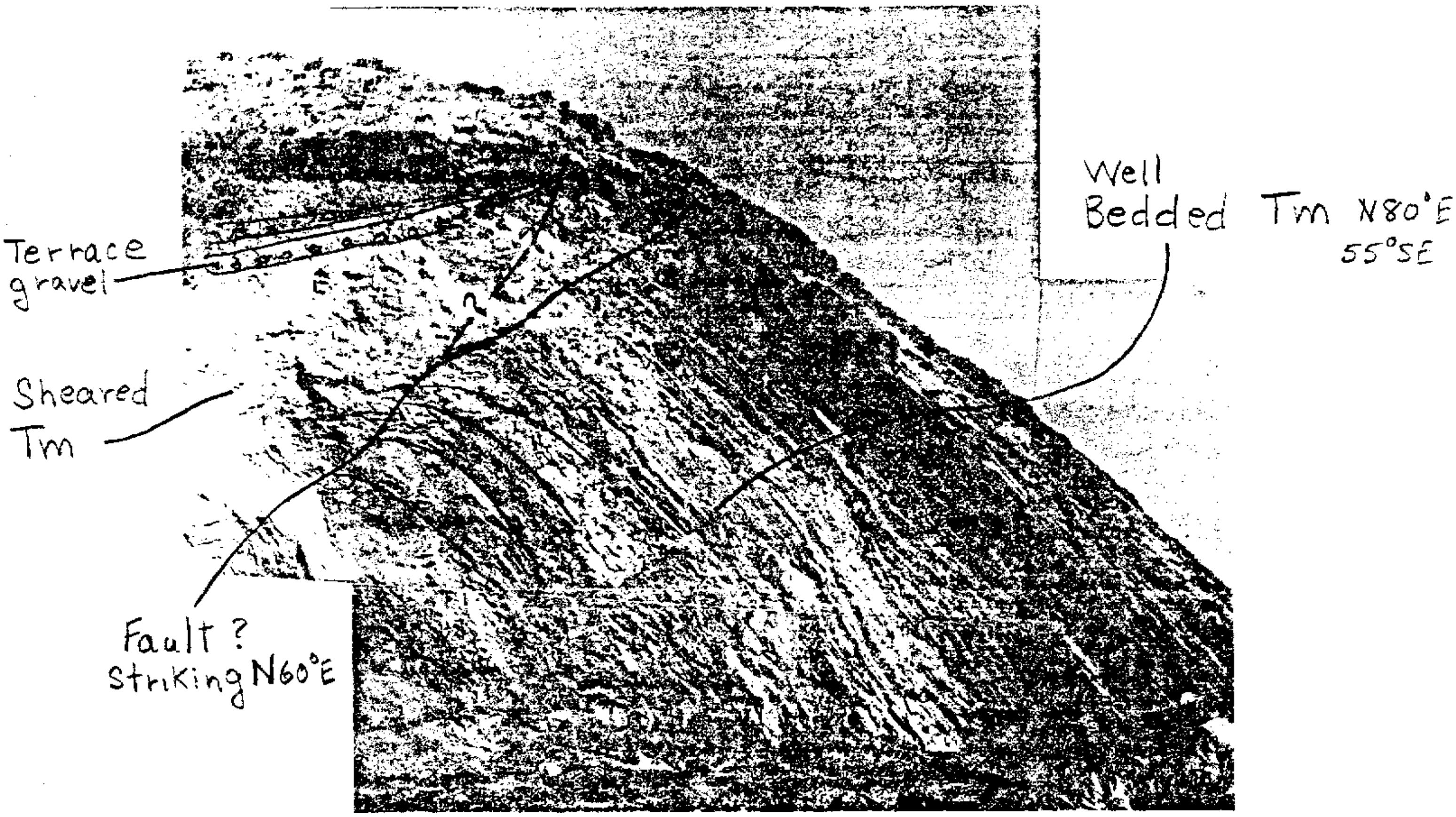
Looking NE along the strike of the fault

Scale

10'

Tm — Monterey Formation

~ ? Fault or boundary ~~of~~ between sheared & well bedded rock



terrace gravels which appear to be slightly upturned and may be faulted against the Monterey Formation. The terrace deposit is not exposed on the east side of this shear zone. It could not be determined, due to the steepness of the seacliff, whether the terrace deposit is actually faulted. The significance of this locality seems to be that the fault is not very well defined. There could be any number of faults within the 300' disturbed zone described above. West of this zone the rocks are not sheared; also the rocks east of zone are not sheared.

8. Conclusions:

Dibblee describes the sense of movement on this fault as oblique-slip, possessing both a normal component and a left-slip component. The NW side is down relative to the SE. The dip-slip component of movement on this fault seems to be the principal sense of displacement on the SW portion of this fault. No evidence of left-slip was observed; in fact, the large scale drag features north of the fault suggest an apparent right-lateral component. Further, the only geomorphic evidence observed, weak though it may be, indicated only vertical offset. No offset drainages, shutter ridges, trenches, or other strike-slip topographic features were seen.

Well-defined fault surfaces were only observed at two localities, 2 and 3. Elsewhere, zones of broken, sheared, and contorted rock as much as 300' in width were seen. Air photo lineations do serve to help locate this fault but some of these lie up to 300' from the mapped fault trace of Dibblee.

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The youngest faulted unit is a terrace deposit at locality 3. As discussed in section 5 of this report, the age of these materials is at least 100,000 years old. The oldest unfaulted unit is a probable Holocene age soil overlying the terrace materials at locality 3. I can not say positively that this soil is unfaulted, but I am supported by Ziony in this conclusion.

9. Recommendations:

Based on the lack of evidence for Holocene activity, this fault should not be zoned under the Alquist-Priolo Special Studies Zones Act.

10. Investigating geologist's name; date:

Edward J. Bortugno

Edward J. Bortugno
Geologist
March 14, 1977

I agree with recommendation.
EWH
3/15/77